Chattooga annual hydrograph

Chattooga base flows are generally low compared to storm peaks which tend to rise and drop rapidly. The seasonal pattern shows higher base flows from November to May (with the highest flows in April). The seasonal flow variation is primarily related to evapotranspiration changes in the summer growing and winter dormant seasons (trees utilize substantially more water when they are gowing), hot vs. cooler temperatures, and more vs. less intense solar radiation.

Figure 10 gives median daily flows for the period of record (in purple) at Highway 76 to show the seasonal variation of base flows. It also includes two recent example years to illustrate the flashy nature of storm events and potential variation between years. 2001 (shown in red) was the driest year since 1940, while 2005 (shown in blue) was the third wettest and was atypical because of two large summer hurricanes (in a more typical wet year, more frequent storms occur in winter).

The shape of the falling limb of the hydrograph after a storm is fairly consistent (receeding at a decreasing rate as flows drop toward base levels), but recessions can be interrupted by additional rainfall events. The average annual flow at Highway 76 over 67 years of record is 650 cfs; this is equivalent to an average of 42.6 inches of water yield over the entire watershed above the gaging station. The average rainfall to produce this average flow is estimated to be over 70 inches per year, and the Upper Chattooga probably receives more than this average because it has a higher elevation.

Based on the regression equations between Burrells Ford and Highway 76, a comparable Upper Chattooga hydrograph (not shown and currently unavailable) would probably have peaks about half the size of those at Highway 76, while base flows are probably about one-third to one-quarter of those at Highway 76. Accordingly, a hydrograph for the upper river is likely to be even more "flashy" than the one shown in Figure 10.

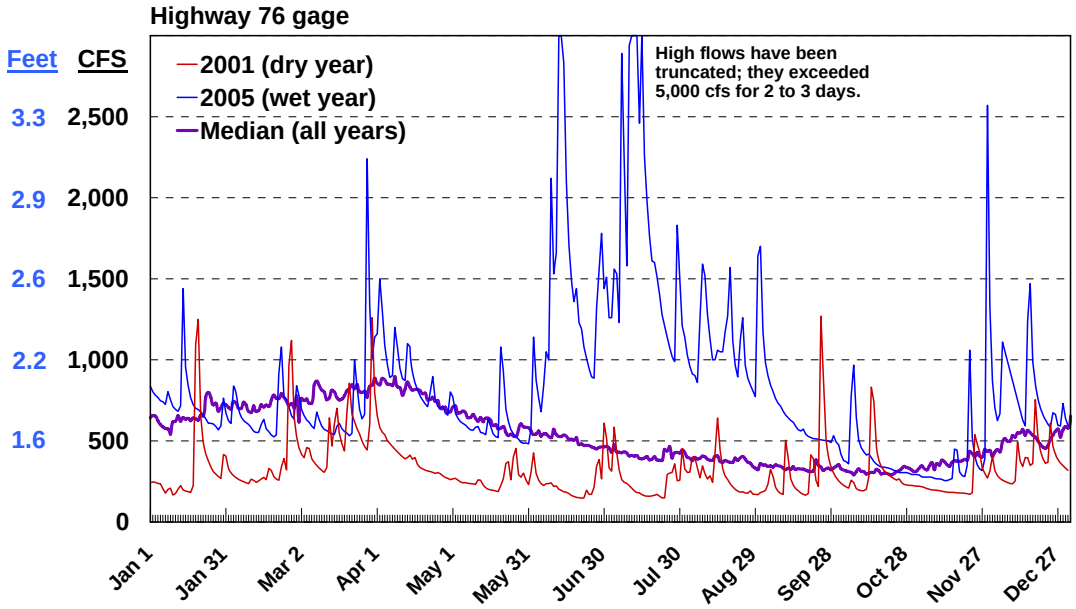

Figure 10. Median daily flows and example wet and dry year hydrographs for Highway 76 gage.

Flow ranges for boating and angling

Expert panel methods

Several sources of information helped develop flow ranges for boating and fishing, but the primary source was the expert panel fieldwork on January 5 and 6, 2007. A longer report provides details (Berger, 2007); it is summarized below.

- Panels included 8 anglers and 8 boaters (with each group accompanied by two consultants). Participants were chosen from self-nominations; the goal was to represent experienced users who could assess how flows affect angling and potential boating opportunities on the Upper Chattooga. Panels included advocates for stakeholder groups interested in the capacity effort.
- Panels assessed the Rock Gorge and Nicholson Fields reaches from Burrells Ford to Highway 28 on January 5th and the Chattooga Cliffs and Ellicott Rock reaches on January 6th.
- Flows were similar on both days:

  Day 1: Rising flows from 340 to 400 cfs (1.5 to 1.6 feet) at Burrells Ford; about 1,100 cfs or 2.3 feet at Highway 76 using the fall/winter storm period equation.

  Day 2: Falling flows from about 400 cfs to 375 cfs (1.5 feet) at Burrells Ford; about 1,100 cfs or 2.3 feet at Highway 76.

  Note: As discussed in the study report, Highway 76 flows on the second day reached 1,400 cfs, but this peak was not observed by panelists because it moved through Burrells Ford during the night.
- Panelists were asked to rate flows on an acceptability scale, and average ratings were used to create "flow evaluation curves." Panelists also answered "specified flow questions" to identify the acceptable and optimal ranges for different types of boating and angling opportunities.
- Anglers generally assessed flows in relation to the Highway 76 gage. This gage is well-correlated with Burrells Ford for angling flows, and anglers have used it for years.
- Boaters assessed flows in relation to the Burrells Ford gage, which better represents flows in the reach. Boaters do not have a long history of using the Highway 76 gage for the upper river (because boating has not been allowed).
- Anglers rated flows similarly for all reaches, so results are combined. They provided separate assessments for fly, spin, and bait fishing, which are shown separately.
- Boaters provide specified flows for "technical" (lower flow), "standard" (higher flows with better whitewater) and "big water" (much higher flows with more powerful hydraulics) boating opportunities.
- Boaters generally assessed flows for kayaks, inflatable kayaks, or whitewater canoes. Although small rafts could probably run these segments at some flows, that use is likely to be rare. Panelists generally agreed that the Upper Chattooga is not appropriate for larger rafts with 4 to 6 people per boat.
- The expert panel report provides detailed findings for boating and angling opportunities. In this report, we have simplified information to highlight major distinctions.

  - For angling, we have focused on the acceptable and optimal ranges for each type of fishing. The best fishing occurs in the optimal ranges; acceptable ranges represent declining fishing quality for most anglers.
  - For boating, we have focused on technical, standard, and big water boating. The best boating occurs in the optimal standard range, and technical and big water ranges represent declining boating quality for most boaters.
  - We have not focused on scenic boating in this analysis; as discussed in Chapters 3 and 4, these opportunities have access issues and are likely to involve small numbers of users. In general, these opportunities can occur at much lower flows than whitewater boating, particularly if they are focused on the 4 miles of alluvial river between Lick Log Creek and Highway 28. If boaters using this reach were willing to walk through the periodic shallow riffles, it is likely "boatable" at even relatively low base flows.

- Many flow-recreation studies require greater precision than can be attained from "single flow reconnaissance" by two panels. Assessing more flows would improve the precision of flow ranges identified below. Similarly, hydrology data show some "noise" in converting assessments from one gage to another. Nonetheless, results are precise enough to identify the "best flow ranges" for each activity, and when flows are acceptable but lower quality. Additional precision is unlikely to change this "big picture," although it may help narrow specific flow thresholds.

Expert panel findings

Figure 11 shows "range bars" for three types of fishing (all reaches combined) and the three types of whitewater boating (separated by reaches). The goal is to identify flow ranges for "optimal fishing" and "optimal standard boating."

- Flow related-conditions for ***angling opportunities*** are optimal at low flows (below 225 cfs at Burrells Ford; 700 cfs at Highway 76). Lower flows provide more wadeable and fishable water, allows easy crossings in most areas, and has good water clarity (although some anglers prefer more "color" that occurs at higher flows).
- The upper end of the optimal range is lower for fly angling and higher for bait angling, with spin angling in between. Fly anglers are more likely to wade, require more casting space, and thus prefer lower flows to gain access to more fishable water.
- Optimal flows for fishing end between 250 and 450 cfs at Burrells Ford (750 to 1,400 cfs at Highway 76), depending upon the type of fishing. Acceptable flows for fishing end between 450 and 650 cfs at Burrells Ford (1,400 to 2,000 cfs at Highway 76). Anglers can still fish higher flows, but wading and crossing more challenging, water clarity decreases, and the amount of fishable water declines.
- Optimal standard boating ranges for the three segments taken together start about 350 to 400 cfs and end about 600 to 650 cfs at Burrells Ford (1,800 to 2,000 cfs at Highway 76). Although the Chattooga Cliffs segment has higher gradient, more constricted rapids, and more logs, the optimal ranges for the three reaches are more similar than different.
- Taken together, range bars show that the highest quality fishing and boating generally occur in different parts of the hydrograph (the exception is bait fishing, which remains optimal through higher flows). The best fishing flows are not the best boating flows, and vice versa.
- Acceptable but lower quality fishing opportunities overlap with optimal boating; acceptable but lower quality technical boating overlaps with optimal fishing. At these overlap flows

some users of each group could be present (if boating were allowed), and encounters could create impacts and conflict (see Chapter 8).

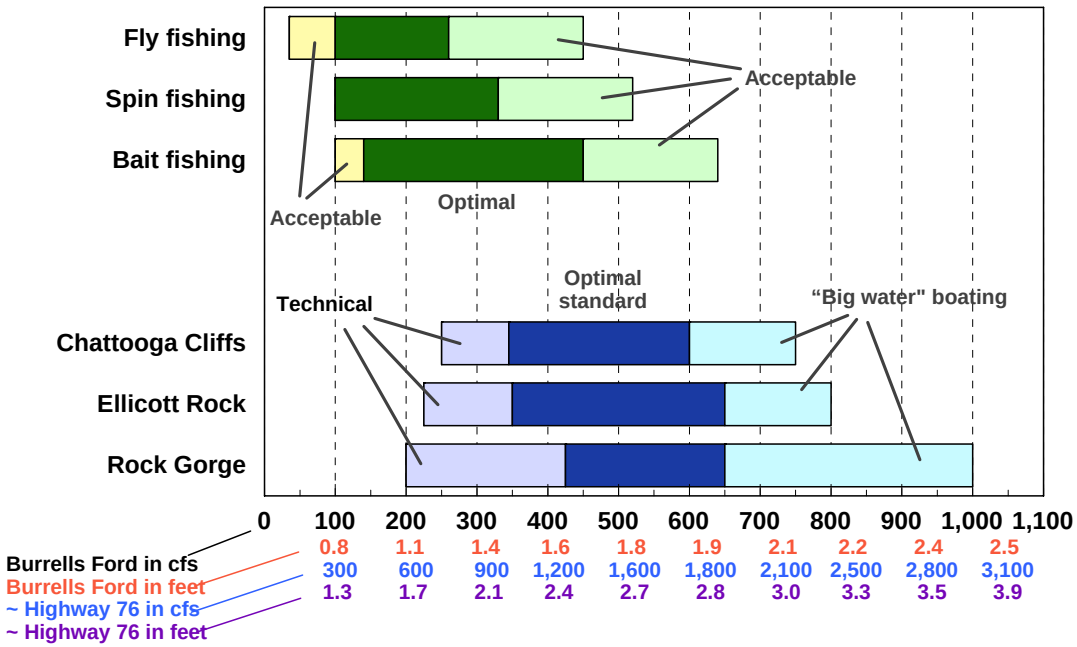

Figure 11. "Flow range bars" for fishing and boating opportunities on the Upper Chattooga.

Flow ranges from other sources

Web articles and angler message board comments. Several web-page articles and message board posts provided ***illustrative*** information about flow ranges for angling. As one example, a web-based article on Delayed Harvest fishing provided the following discussion of flows on the Nicholson Fields reach:

> *"Water levels are an important consideration on the Chattooga because it is free flowing. It will commonly rise a foot or more after a day of rain and become swift and dangerous. Water levels up about 1.8 feet on the U.S. Highway 76 gauge allow for fairly comfortable wading. If the level is higher than 1.8 feet, fishermen will have to pick and choose their entry points. If the water level is much over 2 feet, the Chattooga is probably best avoided until it runs down a little. The good news is that it goes down almost as quickly as it comes up, unless there have been several days of heavy rains." (Samsel, J., 2007)*

Similarly, several fishing reports on the Northern Georgia Trout Online message board offered comments about different flows (usually associated with the DH or Burrells Ford areas). The following parts of messages provide examples:

> *It's still raining like crazy here right now so the Chattooga probably won't be fishable for a day or two now. I don't recommend getting out there if the gage is over 2.0." (Harris, J. January 2006)*

> *It usually takes a pretty good rain to color the Chattooga. Check the gage, if it's over 2', don't try it. ("Fly flicker," February, 2006).*

> *It was pretty high this morning when I got there (9:30am). Kind of made me wish I had a wading staff or at least a fishing partner to inform my next of kin when I fell in. The water levels did drop by about 4-5 inches during the course of the day. Tomorrow I would guess it will still be higher than it has been in a long time but should be ok for wading in most parts. If you wade...be careful. I seriously thought I was going to take a swim on a couple of occasions today. [Mean daily flow on Oct 28 was 968 cfs (about 2.2 feet) and averaged 568 cfs (1.7 feet) on Oct 29] (Chris B., October 29, 2006).*

We have not conducted an extensive analysis of these comments and do not suggest they should be given equal weight with expert panel evaluations. Message boards may not be representative of those who fish the river, are not systematic responses to the same set of issues, might have provided different advice to different audiences (e.g., inexperienced vs. experienced anglers), and the precise timing and location evaluated are not always obvious. In spite of these limitations, message board discussions of flows generally concur with expert panel findings suggesting better wading and fishing conditions occur at flows less than about 2.0 to 2.3 feet at Highway 76 (800 to 1,100 cfs; 300 to 350 cfs at Burrells Ford).

Whiteside Cove fishing reports. A member of the Whiteside Cove Association sent information from fishing logs dating to 1963 (Bamford, 2007). These entries in a log book identify activities on specific dates, which were then associated with a mean daily flow at Highway 76. Despite some methods problems using historical use data to identify flow needs (Whittaker et al., 1993), and the timing problem using a gage over forty miles away, data show that anglers use a full range of flows in rough proportion to the availability of those flows, but their choice of dates also appear to be influenced by other considerations (such as vacation time or day of the week). The expert panel assessment provides more specific information about how quality changes at different flows.

Comparisons with other studies. The literature review included a chapter on flow ranges for boating and fishing from other rivers (Berger, 2007). The lowest acceptable boating flows are typically at least 200 cfs, with some notable exceptions: very small headwater streams, steep streams (e.g., Chelan Gorge, Nantahala Cascades), a modified channel (e.g., Clear Creek whitewater park), and some flatter canoeing streams (Little Susitna, Bedrock Canyon on Dolores River). These results are consistent with the lowest technical flows identified by the boating panel.

The review also suggested that optimal flows for standard whitewater boating are usually substantially higher than minimum flows to get down the river (as shown by expert panel results). On steeper rivers the differences tend to be smaller (e.g., Chelan Gorge, Seneca Reach of Upper North Fork Feather), but on less steep rivers, the higher volume is needed to create good whitewater (e.g., Slickrock Canyon on Dolores River, Lower Kern). The reaches of the Upper Chattooga are to be more like the steeper rivers.

"Number of days" analyses

Given the flow ranges described above, it is possible to use hydrology information from the Highway 76 gage record to assess the number of days with different flow ranges in an average year. Figure 12 shows the days of technical, optimal standard, and big water boating for an average year, and when whitewater boating is unlikely to occur because flows are too low or too high. Table 4 provides the same information, but adds data for example wet and dry years (to show the extremes). Note: This analysis does not assess the frequency of days for potential scenic boating on short segments that do not include the steeper, higher gradient whitewater. In

general, we believe scenic boating on the short flat reaches might be available much of the year, particularly if participants were willing to walk or line boats/tubes through shallow riffles.

The analysis focuses on the frequency of days in specific flow ranges, so terms such as "optimal boating" or "optimal fishing" refer exclusively to flow and not other attributes that affect boating or fishing. For example, optimal flows for fishing that occur in the summer when water temperatures may be too high may not attract many fly anglers, but would be highly valued in cooler months such as October – November or March – April. Similarly, optimal boating flows that occur in January when air temperatures are near freezing might attract few boaters compared to the same flows in March when temperatures are generally warmer.

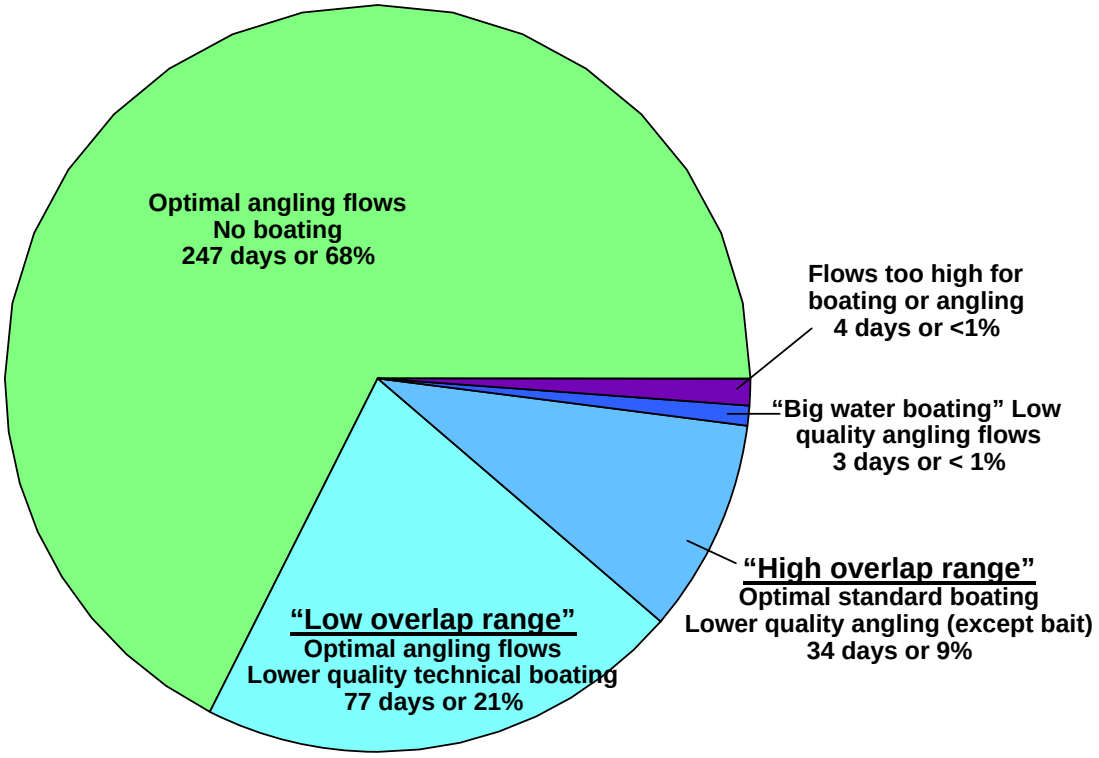

Figure 12. Estimated days per year of boating opportunities (averages for the period of record).

- Flows below 225 cfs (1.2 feet) at Burrells Ford (700 cfs at Highway 76) provide optimal angling flows for of all three types. This is available 247 days in an average year, with no "potential for conflict" because flows are too low for boating.
- Flows of 225 to 350 cfs (1.2 to 1.5 feet) at Burrells Ford (700 to 1,100 cfs at Highway 76) provide optimal angling flows and lower quality technical boating flows. In this "low overlap range," which occurs 77 days in an average year, boating quality is lower and declining as flows drop.
- Flows of 350 to 650 cfs (1.5 to 2.0 feet) at Burrells Ford (1,100 to 2,000 cfs at Highway 76) provide optimal standard boating and lower quality angling (except for bait fishing). In this "high overlap range," which occurs 34 days in an average year, angling quality (except for bait fishing) is lower and declining as flows rise.

- Flows of 650 to 800 cfs (2.0 to 2.2 feet) at Burrells Ford (2,000 to 2,500 cfs at Highway 76) provide big water boating and low quality angling. Flows above 800 at Burrells Ford are too high for boating and angling. These higher flows occur about 7 days in an average year, with no "potential for conflict" because flows are too high for angling, boating, or both.

Figure 13 shows optimal standard boating days for each month. The likelihood of boating flows is higher between December and May, with the highest likelihood months from February to April. As discussed in the "using boatable flows" section below, storms also tend to be larger and last longer in these months, so there is likely to be more advance warning and more hours or days with boatable flows, which make them easier to use.

These optimal boating days, which overlap with lower quality but acceptable fishing, probably also have the greatest "potential for conflict." In these months, boatable flows may occur on about 20% of days, and fishing use is common during these months (particularly in the DH reach). From mid-February through April, other fishing-related conditions aside from flow are commonly optimal (air temperatures, water temperatures, and hatches).

Table 4. Number of days in various boating & angling ranges.

	Burrells Ford		Highway 76		Period of record average	Example dry year (2001)	Example wet year (2005)
	cfs	feet	cfs	feet			
Optimal angling **No boating**	<225	<1.2	<700	<1.9	**247**	352	181
Optimal angling **Lower quality technical boating**	225 to 350	1.2 to 1.5	700 to 1,100	1.9 to 2.3	**77**	9	109
Optimal standard boating **Lower quality angling (except bait)**	350 to 650	1.5 to 2.0	1,100 - 2,000	2.3 to 2.9	**34**	4	59
"Big water" boating **Low quality angling**	650 to 800	2.0 to 2.2	2,000 - 2,500	2.9 to 3.3	**3**	0	6
"Too high" for boating **No angling**	>800	>2.2	>2,500	>3.3	**4**	0	10
Total boatable days	225 to 800	1.2 to 2.2	700 to 2,500	1.9 to 3.3	**114**	13	174

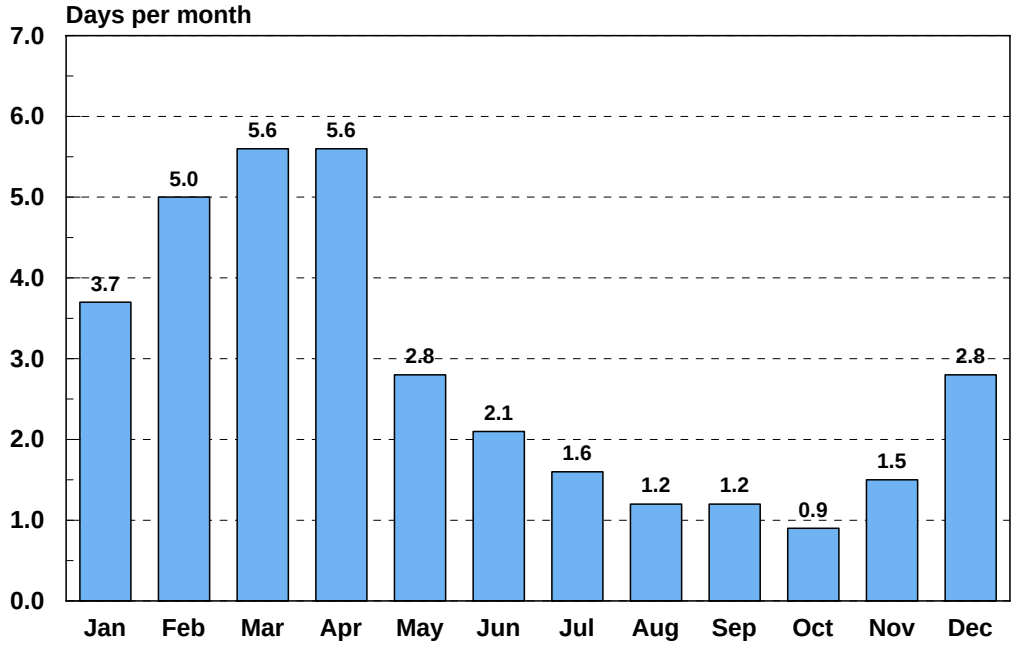

Figure 13. Estimated days per month of standard boating opportunities (averages).

Using boatable flows

As discussed above, peak flows rise and recede quickly on the Upper Chattooga, particularly in summer months. To examine the duration of boatable flows in various seasons, we reviewed data from individual storm events (Burrells Ford gage).

- During the summer, a storm peak flow that reached 850 cfs receded to 300 cfs in only 11 hours. If such a storm occurred in the afternoon, boatable flows would not be usable by the following morning.
- The lower the initial baseflow, the "flashier" the storm flow, and the more difficult it is for boaters to use it. During the summer, 3 inches of rainfall is probably needed to produce a one day boatable period, and boaters would need to start about 480 cfs to ensure the entire trip remained above 350 cfs.
- During the winter-spring season, a storm that reached 1,600 cfs receded from 900 to 300 cfs in about 36 hours, three times longer than the summer example. During a storm that reached 3,000 cfs, 900 cfs to 300 cfs took 47 hours (two days of boating). Although more predicatable, such storms usually provide only 1 to 2 days "notice" and 1 to 2 days of boatable flows.

This review suggests only large storms (or a series of close-together storms) are likely to produce boatable flows with enough "notice" and duration for most boaters to take advantage of them. For "ideal conditions," storms need to be predicatable at least a day in advance and the boatable range needs to be available for several hours in daytime after the storm is clearly waning.

Flow issue conclusions

Studies on many other rivers show that better boating flows are higher and better fishing flows are lower. When natural flow regimes provide a range of flows through the year, these two groups tend to separate and there is less likelihood of conflict. However, there are overlap ranges on the Chattooga, and they occur more often than estimated during the Sumter Forest plan update in the early 2000s. On the Upper Chattooga, boaters can probably get down the river at lower flows, and optimal standard boating starts at slightly lower flows, than was believed prior to the expert panel fieldwork.

However, for many days in the "high overlap" period, boater-angler conflict and related capacity problems would be unlikely. These are lower quality fishing days for all but bait anglers, and they tend to occur in winter when bait angling use is low. Some fly and spin anglers certainly fish these flows, particularly in March and April on the DH reach, but they have lower quality flow conditions in comparison to the other 320 or so days per year that have lower flows. For boaters, these optimal flows are also infrequent and difficult to predict, requiring attention to weather reports, and a flexible work schedule to take advantage of them. Most boatable days come during or immediately following a storm, and the "boatable window" may be less than a day, particularly in summer. In addition, only about 10 of these "best boating days" are likely to occur on weekends or holidays (assuming about 30% of days are on weekends/holidays, and boatable days are distributed randomly). Realistically, only optimal flows on a weekend day are likely to produce the maximum boater use levels identified in Chapter 4.

For the "low overlap" period, the converse is true. These are high quality fishing flows, but lower quality technical boating flows. There are more of these days (77), and they tend to occur in warmer times of the year (when angling use is higher and boaters might be motivated by good weather). In this "overlap range" management actions (such as use limits, separation by segments or timing) may be necessary to protect high quality fishing if boating were allowed.

8. Management Actions

This chapter begins with a brief discussion of recreation capacity and conflict concepts. It then reviews management actions that might be used to address specific "impact problems" or conflicts on the Upper Chattooga, their likely effects, keys to success, and examples from other rivers.

Distinguishing Capacity and Conflict

Carrying capacity is sometimes used as an "umbrella" concept to refer to any overuse or visitor-impact issue, including conflicts between users. However, it is useful to distinguish between these terms and management strategies that may be used to address them.

Carrying Capacity

Carrying capacity is defined as the level of use beyond which impacts exceed standards (Shelby and Heberlein, 1986). It has roots in range management and Hardin's (1968) "tragedy of the commons." Individual behavior is not the problem, but as each new person visits a park or a river, they may incrementally and collectively degrade biophysical resources or the experiences of all (Vaske, Donnelly & Whitttaker, 2000; Manning, 2007). The general solution is to set limits – in Hardin's words, "mutual coercion, mutually agreed upon" – which requires agreement about management objectives and specific standards that define when impact levels become unacceptable (Shelby & Heberlein, 1986; Manning, 2007).

Recreation planning frameworks that address carrying capacity (including Limits of Acceptable Change) link management objectives, standards, and actions in slightly different ways, but they all are based on two major premises: 1) all use causes some impact; and 2) defining a capacity (or choosing other actions to meet standards) requires "lines in the sand" (standards) about how much impact is acceptable.

Conflict

Recreation use conflict is related to, but different than, carrying capacity. At its root, conflict implies an incompatibility between two recreation activities, with one group generally showing a "zero tolerance" for another group's activity or behavior. Under this strict definition, there is little room for defining "acceptable impact levels."

In the real world, some conflicts are "zero tolerance" (e.g., motorized use in Wilderness), while others are multi-faceted and may allow some level of contact or impact (e.g., skiers and snowboarders at a ski resort). Successfully addressing conflict requires understanding the impacts which cause problems, the type of conflict (see discussion below), and its overall intensity. The following bullets highlight conflict research findings:

- Conflicts between different groups are well-documented in the recreation literature (see Graefe & Thapa, 2004 for a review). The most commonly studied conflicts are between motorized and non-motorized users (e.g., motorboaters and floaters; snowmobilers and skiers; hikers and ATV users), but some work has examined other activities (e.g., hikers and mountain bikers; hikers and stock users; waders, snorkelers, and motorboaters; walkers, runners, in-line skaters, and bicyclists; and skiers and snowboarders).

- One model defines conflict in terms of "goal interference" attributed to another group's behavior (Jacob & Schreyer, 1980). Contact can be direct (e.g., a rafter encounters a motorized boat) or indirect (a skier sees a track left by a snowmobile); it can also refer to people doing the same activity (e.g., conflict between partying vs. quiet campers).
- "Goal interference" does not require conflicting groups to have different goals (e.g., they both may be interested in "experiencing nature," "getting exercise," "being with friends," etc.), but it implies the behavior of one group somehow prevents the other from achieving their goals (Gibbons & Ruddell, 1995).
- The goal interference model (Jacob & Schreyer, 1980) suggests four factors that may intensify conflict: 1) groups more intensely involved in their activities; 2) groups with greater "place attachment;" 3) groups engaged in more "focused" (sensitive to the environment) activities; and 4) groups with lower tolerance for "lifestyle diversity." Research has found qualified support for some of these factors; demographic variables (age and gender) may also play a role.
- Todd (1987, as reported in Graefe & Thapa, 2004) is the only study we've found specifically examining conflict between non-motorized boaters and anglers. Conducted on the Delaware River, this master's thesis showed more conflict within an activity (canoeists with other canoeists) than with other users (anglers, motorboaters, tubers, and rafters), and more conflict with groups behaving discourteously than from the mere presence of another group.
- An alternative to the goal interference model defines conflict in terms of incompatible norms about appropriate activities or behavior. This applies normative theory (which underlies capacity research) to conflict, and focuses on specific impacts and evaluative standards of them as acceptable-unacceptable (Whittaker & Shelby, 2004).
- Many conflicts are "asymmetrical" – group A reports adverse impacts from group B, but not the converse. As conflicts escalate however, it is common for Group B to develop antipathy toward Group A (although it may be more generalized) (Graefe & Thapa, 2004). "Asymmetrical antipathy" explains why the "non-sensitive" group may be willing to "share" while the sensitive group may not; "sharing" does not have the same price for each group.
- Not all conflicts require contact in the resource setting. Vaske et al. (1995) distinguish "face-to-face" conflict and "social values conflict," where the sensitive group opposes an activity that they believe is inappropriate regardless of whether they encounter it. Vaske et al. found social values conflict among big horn sheep viewers on Colorado's Mt Evans, who considered hunting inappropriate, even if it occurred in a different season. In contrast, Vaske et al. (2006) found more face-to-face than social values conflict among hikers regarding mountain bikers. For several Alaskan rivers (e.g., Situk, Delta, Togiak NWR rivers), we have found social values conflict among about one-third of non-motorized users (toward motorized boaters).
- Sensitive groups often develop long lists of specific impacts that may be caused by the offending group, making it challenging to pinpoint the underlying "causes" of antipathy. Categories include biophysical impacts (e.g., jet boats erode stream banks); social impacts (jet boats are too loud); and safety impacts (jet boats may collide with or capsize canoes). When in-groups and out-groups have been established in a conflict, the lists of "problems" may grow long and include scapegoating, where unrelated impacts are blamed on the offending group (Whittaker & Shelby, 1993).
- Some assertions in conflicts are based on philosophical or value-based perspectives about appropriate recreational uses and management goals (e.g., whether a river should be managed

as wilderness). Weighing the importance of one argument versus another is challenging, particularly in polarized, politicized, and legal/adversarial environments.

- In a study of motorized and non-motorized trail users on Kodiak Island (Alaska), more active trail users (enthusiasts) held more polarized opinions about conflict and solutions than the general public (Whittaker, 2004). Graefe & Thapa (2004) caution that conflicts are not always "high and growing."
- Most efforts to reduce conflicts in recreation settings focus on 1) separating uses by space or time; 2) using "technical fixes" to reduce objectionable impacts; 3) educating users about the impact issues to minimize conflict behavior (if possible); and 4) developing new "norms" that support solutions that are viewed as "fair" (Graefe & Thapa, 2004; Whittaker & Shelby, 2002).
- Vaske et al. (1995) suggest social values conflicts are less well-addressed by separation strategies, arguing instead for education to reconcile misconceptions about the offending activity. We have less confidence that education can modify social values, and believe that separation remains an important tool. For example, "no motors in Wilderness" and "no hunting in National Parks" are separation solutions to conflicts that probably have substantial social values components. However, we recognize these two examples have been "settled" through federal laws with clear mandates; developing "fair" separation strategies can be more challenging in areas without such mandates.

Research on conflicts has looked at backgrounds and attitudes of users, economic impacts, safety, enforcement problems, and ecological impacts (Kuss et al., 1990; Graefe & Thapa, 2004). These issues are interesting and important, but they tend to obscure the more central issue, which is the nature of contrasting experiences in conflicts (Shelby, 1980). If a sensitive group feels that another use decreases the quality of their experience, it is important to understand whether a primary impact is to blame, or a more global objection. If two activities are incompatible and both are to be provided, "zoning" options that equitably share the resource (perhaps capitalizing on natural use patterns) are usually the best solution.

Conflict and capacity on the Upper Chattooga

The potential addition of whitewater boating on the Upper Chattooga appears to have both conflict and capacity components, with the conflict illustrating many classic characteristics (asymmetry, interference impacts, and contrasting definitions of appropriate use).

For some proportion of current users (particularly hikers who spend most of their time on designated trails and that do most of their hiking in summer or fall), the mere presence of boating is unlikely to be the problem, although they may prefer encounters with boaters to be low and infrequent. For these users, ***capacity is probably the primary issue***.

Many of these users are concerned about boating use because of high boating use levels on the Lower Chattooga (up to 200 people per day on some segments) or other rivers (e.g., the Nantahala and Ocoee). Although this report estimates that use levels on the Upper Chattooga are likely to be much lower (but still might approach 70 boaters per day on the highest use segment), there are concerns about numbers of boatable days and the number of boaters that would use them. For these users, ensuring there are low numbers would probably alleviate most of their concerns.

For other users, particularly anglers interested in using "overlap flow ranges" (see Chapter 7), boating use would create encounter and interference impacts, which introduces conflict. Capacity

may be relevant for those willing to tolerate two to three interference impacts per day; for others, even low boating use could be disruptive. For these users, ***face-to-face conflict is the central issue***, and actions such as separation during overlap periods become more important.

For still other users (which may include anglers, hikers, or others with a preservationist philosophy), there is probably ***social values conflict*** (rather than face-to-face conflict issues) is probably driving their antipathy toward boaters on the Upper Chattooga. Boating has been absent for 30 years (and was rare even before that), so the "current baseline" setting lacks boats. It is not surprising some believe that is how the place "should be" and resist any change. For these users, any boating represents a "problem" even if they have no face-to-face encounters; the 1976 boating closure to protect these opportunities is considered a "compromise solution," and any additional boating erodes it.

Deciding which group of upper river users "deserves priority" is a major challenge. No survey data estimate the relative numbers of users who see boating issue in terms of capacity, face-to-face conflict, or social values conflict, and such data probably might not be decisive in any case (for example, what percentage of users in any particularl category would be sufficient for decision-makers to give it priority over alternative groups?) In searching for "balances" among competing groups, the best course may be to develop 2 to 3 alternative combinations of actions to compare to the "no action" alternative, then let the public react to the analyses of various impacts.

Major types of actions

Visitor impact frameworks (such as LAC) recognize several ways to review current management and address impact problems that exceed standards. The rest of the chapter reviews categories of actions, the impacts they address, keys to successful implementation, and example rivers where they have been used.

The discussion centers around two "action-impact" matrices (Tables 5 and 6). These show which actions are likely to affect which impacts, and allow readers to focus on a particular action (to see what impacts it will address) or a particular impact (to see what actions might help address it). The first matrix examines development, education, and regulation alternatives; the second examines use limit and conflict separation actions.

Development / improvement / maintenance actions

Development actions typically use a "technical fix" approach and refer to "capital improvements" that modify the environment. Development actions are important when creating new recreation opportunities and maintaining or enhancing existing opportunities. In general, these actions are used to minimize biophysical impacts, enhance wildlife, or provide expected services. Examples of development / improvement actions that may be helpful on the Upper Chattooga include:

Trail redesign / maintenance

These actions focus use away from sensitive sites and harden heavily used areas (Cole 1979; 1987; Hammitt and Cole 1987). In the Upper Chattooga, the issue is ensuring that trails handle the volume of use without unacceptable erosion. The recent Forest Service inventory of trails and erosion problems provides a good start for identifying potential maintenance, re-design or closure locations. Trail redesign is a common approach to trail impacts in WSR plans; prominent examples include the Upper Rogue, Metolius, and Wilson Creek (Diedrich, 2007).

Camp rehabilitation / reorganization

This action reduces biophysical impacts at camps (litter, cut trees, bare soil, etc.), usually through "hardening" or creating barriers that funnel use to durable areas or away from "redundant" social trails and satellite sites. At several camps on the Upper Chattooga, another major issue is moving camps back from the river or other water sources (to minimize erosion). The action may help reduce camp encounters or large group encounters by "organizing" which sites campers should use (designated sites out of sight and sound of each other).

The Forest Service monitoring effort identifies camps with larger "footprints" and water-proximity problems. These are candidates for redesign or closures in order to meet standards. Formal designation of specific sites (which relates to education actions) can be part of this action. Camp rehabilitation / reorganization is a common approach on WSR rivers; prominent examples include the Metolius River and in Hells Canyon.

Wildlife openings

It is sometimes possible to "develop" improved habitat or create attractions that increase or concentrate wildlife. Similar to other "technical fixes," this includes large-scale habitat manipulations (e.g., prescribed burns that increase ungulate browse; increasing woody debris for fisheries, or flow manipulations for riparian habitat). On the Upper Chattooga, the primary option is creating wildlife openings (fields with better waterfowl habitat in an otherwise forested environment).

Backcountry pit toilets

This development action addresses human waste impacts in areas of concentrated backcountry camping use. Pit toilets are generally considered inappropriate in primitive settings, but they can be effective. On the Upper Chattooga, the large camping flat near the confluence with the East Fork would be a candidate, except that it is in designated Wilderness. If other camping areas in the Rock Gorge or Nicholson Fields reaches are used by large numbers of groups, pit toilets may be preferable to human waste impacts. These types of toilets were common on several WSRs (Rogue, Hells Canyon, Middle Fork Salmon, and Main Salmon) through the late 1990s, but they have been reduced since then. They are still used in some locations on the Lower Deschutes (Oregon) and Gulkana (AK).

Develop more single party camps

One way to address camp encounter or camp competition impacts is to create more camps. Based on current use and camp information, there are adequate numbers of camps on the Upper Chattooga, but "bottleneck" areas may create problems. Developing single party camps out of sight of sound from others could be helpful. This action works with camp rehabilitation efforts to ensure an appropriate number of camps, but it may exacerbate trail encounters by attracting more use. It needs to be coordinated with education efforts so users know locations and regulations. This action has been used on several WSRs, including the Pecos, Wilson Creek, and Lower Deschutes.

Clean-up patrols

Addressing litter impacts often simply means conducting more frequent clean-up patrols (or coordinating similar volunteer clean-up efforts). The biophysical monitoring effort conducted in 2006-07 can help prioritize trail segments and campsites that require greater emphasis. Many WSRs have active patrol programs.

Education

Education actions are often viewed as a panacea for addressing human-caused impact problems (Roggenbuck 1992); the idea is that people who "understand" the impacts they cause will behave differently. Compared to regulatory approaches, education is appealing because it is less obtrusive (Fish and Bury 1981). On rivers, education actions often focus on teaching etiquette (e.g., norms to minimize camp competition) and minimum-impact practices (e.g., no-trace camping or human-waste disposal), but may also be used to disperse use to lower use times or places. Education is most effective when it helps users better accomplish their existing goals using equipment which is available to them (e.g., education about more effective backcountry food storage practices, using agency-supplied bear-proof containers). Education actions that may help on the Upper Chattooga include:

Reducing/dispersing use via information

This action reduces impacts indirectly by dispersing use through information about use levels, bottleneck areas, or other impacts (Lucas 1981; Krumpe and Brown 1982). For example, if hiking densities are publicized, some people will avoid higher use times to match their preferences. Information to disperse use helps visitors choose the type of experience they want, or allows them to "prepare for" the conditions they are likely to find. Research suggests such information is highly valued by users, although it seldom has major effects on use patterns (Roggenbuck 1992).

On the Upper Chattooga, information about use levels in different parts of the corridor or at high use camps sites could benefit interested in solitude. Grand Canyon uses information to disperse camping in bottleneck areas and many WSRs provide general information about seasonal and weekday/weekend use patterns.

Leave no trace education

This action teaches users better backcountry practices to limit biophysical impacts. Messages focus on litter disposal, human waste practices, minimizing the size and use of fires, and avoiding new user trails or campsites.

Persuasion and attitude change literature in other natural resource areas suggests that some behavior modifications are possible with well-developed educational efforts, but "engineering" long-term, lasting change is challenging and complicated (Roggenbuck, 1992). Designing and implementing effective education campaigns requires clear understanding of persuasion and communication theory and practice, which is often missing from natural resource management efforts (Manfredo, 1992; Whittaker, Vaske, & Manfredo, 2002).

As with many behaviors based on "environmental ethics," widespread conformity depends on whether people recognize the consequences of their actions and accept responsibility for them.

Most agencies support "leave no trace" education efforts, but fewer river managers have developed or implemented a multi-faceted program.

Etiquette education

This action changes discourteous behavior that may exacerbate encounter or competition impacts. Etiquette issues on the Chattooga include camp proximity (don't camp within sight or sound of others), fishing proximity (don't fish too close to other anglers), and best ways for boats to pass anglers (if boating is allowed).

Similar to "no trace" education, effective etiquette campaigns can be challenging and probably need to be multi-faceted. Etiquette information is commonly available for WSRs through brochures, maps, or signs at launches and trailheads, but we have not seen research evaluating their effectiveness.

Regulations

Regulatory actions usually employ a "structural fix" approach, focusing on changing behavior to minimize impacts. They may be effective when educational alternatives fall short, although the two approaches are complementary (Lucas 1982), because regulations can reinforce educational efforts, regulations become widely known through education, and they "educate" users about problem behaviors (and the impacts they cause). Regulation actions that may help on the Upper Chattooga include:

Fire regulations

Fire regulations include limiting fires to existing fire rings, requiring fire pans, or prohibiting fires altogether. Such regulations might decrease firewood collecting (and related tree damage), or minimize the number and size of fire rings at camps. Fire regulations have been used in alpine environments where firewood is scarce and on western rivers where wild fire dangers are more common, and in many cases fire ring impacts have virtually been eliminated. However, the Ellicott Wilderness user study shows little support among current users for fire regulations (Rutlin, 1995).

Human waste regulations

Most multi-day western rivers require boaters to carry out human waste via portable toilet systems, and some agencies are experimenting with similar rules for climbers in high use areas. On multi-day rivers, these systems are widely accepted and have virtually eliminated human waste impacts. However, carry-out regulations require equipment investment from users (portable toilets) and agencies (scat machines), and a major shift in user norms, and equipment is also not well-suited for backpackers.

Regulations to reduce wildlife impacts

Regulations are commonly used to protect wildlife habitat or prevent wildlife disturbances. Area closures, or prohibitions of certain types of use, are the most common approaches. Examples include 1) boating restrictions where bald eagles nest or feed and buffer zones around eagle nests (Anthony et al., 1995) and 2) dog prohibitions or leash laws for areas with nesting bird colonies

(Burger, 1995). Current studies have not identified species or habitat requiring such regulations on the Upper Chattooga.

Fishing regulation changes

Fishing regulations are commonly used to manage the number of fish caught and harvested, but they can also affect use levels, types of use, and angler behavior. For example, catch and release regulations tend to attract more specialized anglers interested in trophy fish, but eliminate bait anglers interested in harvesting fish. The Delayed Harvest regulations on the Nicholson Fields reach have almost certainly modified use patterns during the DH season and thus affect preferences or tolerances for encounters or other uses by current users. Any major changes in stocking patterns would also likely affect the number and type of anglers, which could affect impacts (e.g., lower summer stocking for harvest would probably reduce bait angling and attendant litter).

Regulations can also reduce competition or interference impacts between different types of anglers (e.g., boat vs. bank anglers). This is a primary strategy on several western rivers desgined to limit interference impacts from boat-based anglers on shore-based anglers. Rivers with "no fishing from a boat" regulations include the Madison, Ruby, Beaverhead, Big Hole, Rock Creek, and Blackfoot in Montana, the Deschutes in Oregon, and the Kenai in Alaska. We are not aware of similar regulations on eastern rivers, although they are apparently being contemplated on the Delaware. These regulations are only effective if boaters are interested in fishing; they do not address impacts from whitewater or scenic floaters.

Use limits

As discussed in Chapters 5 and 6 on impacts, use limits tend to be more effective for addressing social impacts (encounters, competition) than biophysical impacts. Use limit actions that may help on the Upper Chattooga include:

Limits on numbers of boaters

Limits on boater numbers are probably the best way to ensure that boating use (if allowed) does not substantially increase encounter rates in the river corridor. Boater limits (of both private and commercial use) are a central management tool for over 25 rivers (most in the west), and have reduced encounter and camp competition impacts to acceptable levels. Limits on commercial use appear to be in place on at least 50 other rivers, and can be effective at limiting certain types of social impacts if commercial use makes up a substantial proportion of all use.

In several cases, permit systems apply only to boaters with no limits on other uses such as hiking access or fly-in access (e.g., Rogue, Selway, Main Salmon, Middle Fork Salmon, Hells Canyon, Kern). In other cases permits are required for all overnight trips (e.g., Colorado in Grand Canyon, Yampa/Green in Dinosaur National Park, Forks of the Kern) but are not specific to an activity. Rivers managed for very low density Wilderness experiences include the Forks of the Kern (15 private boaters per day) and the Selway (one launch per day).

To meet the range of encounter standards described for various groups on the Upper Chattooga (see Chapter 6), reasonable limits to consider in alternatives would probably fall between 2 and 6 groups (10 to 30 boaters) per segment per day. Limits might be different for different segments (e.g., lower numbers on Chattooga Cliffs because of its difficulty, higher numbers on Ellicott

Rock because it has less angling use), or for different flow ranges (e.g., lower numbers for the "low flow overlap" range and higher numbers for the "high flow overlap").

Limits on numbers of day users

This action could address hiker-to-hiker trail encounters, and would make the most sense on high use summer weekends. It is unlikely to address other social impacts. With the exception of use limits in a few alpine areas (e.g., Mount Whitney, Mount St. Helens), we are not aware of day use limits on WSRs. Smaller park units (e.g., state and regional parks) may limit use levels by parking lot capacities (which act as *de facto* day use limits, see below).

Limits on numbers of anglers

This action would address fishing competition, on-river encounters, and possibly angler-boater encounters (if boating were allowed). The most likely place for such limits is the Nicholson Fields reach on weekends during DH season. Limits on anglers are relatively rare on public land, but have been used in some places (e.g., Georgia's Duke's Creek) to provide low density fishing experiences.

Limits on overnight use

Limits on overnight use are the most common capacities in river and Wilderness settings, and several wilderness units in the Southeast require overnight permits to address camp encounters or camp competition. These limits also allow "marginal" camps to be closed, thus reducing camp impact problems. Linville Gorge NC is a river in the southeast with overnight use limits (50 permits at one time, applicable from May to October), but this is mostly directed at hiking groups. Some boaters do run the challenging Class V+ gorge, but fewer apparently do so as an overnight trip.

A variation on overnight use limits may include designating and assigning camps, which allows more complete utilization of camps. This makes the most sense for "bottleneck areas" with camp competition. The Middle Fork Salmon in Idaho has assigned camps (in addition to use limits); commercial camps on the Lower Chattooga are also assigned.

Frontcountry parking limits

An alternative to limiting use via permits is to limit facilities at access points (parking lot sizes). This is the implicit strategy at many frontcountry park areas (e.g., public beaches, county and regional parks); it is an explicit strategy of some state parks along Alaska's Kenai River during high use salmon angling seasons (with the number of parking spaces linked to the number of available fishing sites). This action is successful only if it is illegal or impossible to park outside designated lots.

Group size restrictions

Group size regulations are commonly employed to minimize social and biophysical impacts in backcountry areas, and they can be effective if there is a relationship between group size and impacts. This action is likely to reduce large group encounters and perhaps address some site impacts.

Considerations for developing permit systems

If the Forest Service developed a permit system for boaters, anglers, hikers, or overnight use, there are several implementation issues. Major decisions include 1) will permits be available by reservation, first-come/first-served, or by lottery; and 2) will an administrative fee be charged? It is beyond the scope of the present analysis to sort through these issues, but the effort to administer (and educate users how to use it) are potentially substantial. If such a system were considered, we have developed a short list of features that might be incorporated in such a permit system for boaters (if that use is allowed). Because boatable days are rare, difficult to predict, and require boaters to be spontaneous in their trip planning, a permit system would have to be efficient. The following features are likely to help:

- A ***"pre-registration"*** component to put potential permit applicants into a system and provide numbered tags for boats.
- A ***"boat/no boat" prediction*** from the Forest Service two to three days prior to prospective boating days, based on existing flows and projected weather. If boating seems likely, pre-registered applicants would be encouraged to apply for the limited number of available permits.
- Boater ***applications might close*** mid-afternoon one day prior to the prospective boating day.
- The Forest Service would make a final ***"boat/no boat" decision for the date*** and ***select permittees*** from among applicants; permit winners would receive an email.
- Winning applicants would ***accept or decline the permit*** by 8 am the next morning (giving them a final opportunity to see if flows and weather are acceptable). Cancelled permits could be made available to others at that point.
- The Forest Service would post boat tag numbers of those with permits, and boaters would display their tag and carry the email permit while on the river.

Developing a larger use limit system that applies to all users might have similar administration issues, because most Upper Chattooga users are day users, and most are likely to have short planning horizons.

Separating uses to address conflicts

Earlier chapters document the potential for conflict between boaters and other users (if boating were allowed), and the most important impacts (on-river encounters and interference with angling). The opening section in this chapter describes use conflicts and the ways they are usually addressed (separating uses by space or time, or modifying norms about acceptable uses). Examples of conflict-reduction actions include:

Separating uses by space

The year-round boating closure above Highway 28 used this approach, essentially managing for boating on the lower river and non-boating activities on the Upper Chattooga. Variations might include closures for shorter segments and/or shorter time periods. Given current impacts and use patterns, the most beneficial ***segment separation options*** focus on the three frontcountry areas and the Nicholson Fields (DH) reach (if boating is allowed on the longer reaches):

- A boating closure at Sliding Rock (particularly in warmer months) could prevent conflicts between boaters and swimmers at this site (if boaters were otherwise allowed to use the

segment). This is unlikely to have a substantive effect on boaters running the Chattooga Cliffs reach, even if boaters used the pool below the slide as a starting point for their trips (which would only occur if the river though private land below Grimshawes Bridge was adjudicated in favor of public access).

- A boating closure for ¼ mile on either side of Burrells Ford Bridge. This could require boaters to take out above (when running the Ellicott Rock reach) or to put-in below (when running the Rock Gorge reach) that area. This involves a longer "carry" to the launching areas, but boaters currently portage similar distances at most Lower Chattooga launches. It would slightly increase trail use in the Burrells Ford area, but many of those trails are heavily used already, and could be redesigned to handle the boater traffic if necessary.
- A boating closure from Lick Log Creek or Reed Creek to Highway 28 (particularly during DH season). If boaters were allowed to use the Rock Gorge Reach but were required to take-out at Lick Log Creek (the ¾ mile trail to Thrift Lake), all boater-angler encounter and interference impacts would be eliminated in the Nicholson Fields or DH reach, arguably the "highest-value" fishing reach. This reach is mostly flat or Class I water, and less interesting to whitewater boaters, but such a closure would eliminate potential scenic boating (canoeing, boat-based fishing, or tubing) opportunities during periods when it is in place.

Separating uses by space (zoning) is among the most common ways of addressing use conflicts in land-based settings; for example, most national forests include include distinct areas where motorized and non-motorized uses can occur. In river settings, segment zoning is also common, particularly for separating motorized and non-motorized uses (dozens of WSRs or segments have been designated non-motorized). Zoning by space to address conflicts between non-motorized boating and other uses is more rare, but examples include non-motorized boating closures on all rivers in Yellowstone National Park, segments of the Merced and Tuolumne in Yosemite National Park, and the North Umpqua in Oregon (with a five mile reach closed to boating during peak steelhead season). The North Umpqua closure is by recommendation rather than formal regulation, but appears to have near complete compliance. We are unaware of non-motorized segment closures (aside from the Upper Chattooga) in the southeast.

Separating uses by time

An alternative approach is to separate uses by time, which includes seasonal, day of the week, or time of day closures. Given current impacts and use patterns, the most beneficial timing options would focus on the DH season, the higher use summer and fall color seasons, or certain times of day:

- A boating closure on the Nicholson Fields reach during the DH season would prevent conflict between anglers and boaters in the "highest-value" fishing reach during the "highest-value" fishing season.
- A boating closure in summer and early fall would address conflicts between boaters and hikers during the "highest-value" hiking season.
- Limiting boating to the middle of the day (e.g., 10 am to 5 pm) could reduce angler-boater interaction during late spring, summer, and early fall (when better fishing is in mornings or evenings). However, both groups prefer the middle of the day from November to about February (the majority of likely boatable days).

Several WSRs have timing restrictions. For example, the North Umpqua has boating time of day restrictions to minimize impacts on anglers (who tend to fish mornings and evenings). Similarly,